# Classifying Multiple Platform Missions
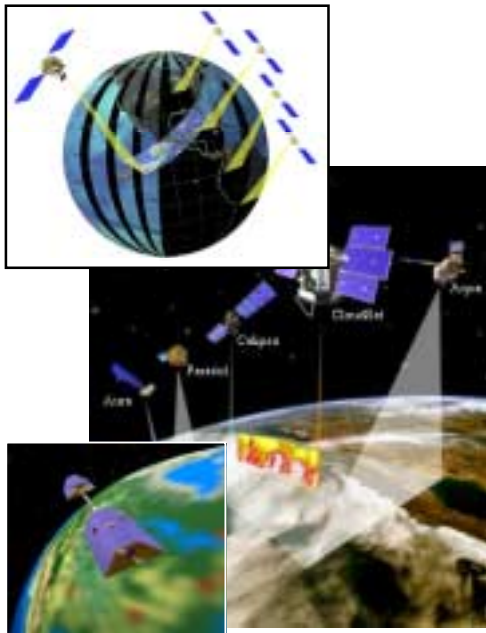
## Dr. Tony Barrett

Artificial Intelligence Group

Exploration Systems Autonomy Section

# Motivating Issue

- ## Why find commonalities?
  - Many multi-platform missions are coming!
  - How can we cost-effectively manage them?

**Origins Program**

NMP

**Earth Observation**

**Sun-Earth Connections**

NMP

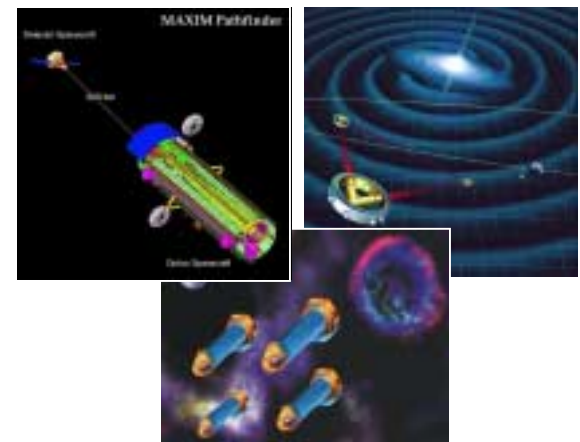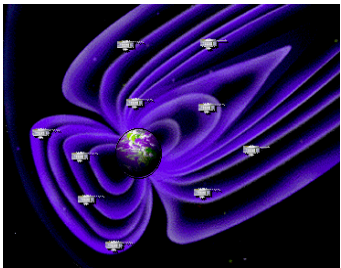**Mars Network**

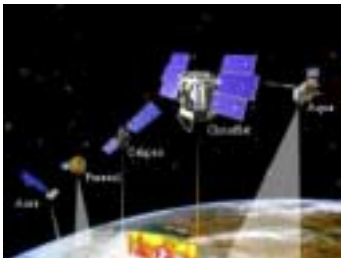**Structure & Evolution of the Universe**

# Three Classes

- Large virtual instruments
  - Spacecraft formations to catch a remote signals
- Sensor webs
  - Spacecraft cover a region to catch local signals
- Virtual spacecraft with evolving sensors
  - Spacecraft capture coincident observations
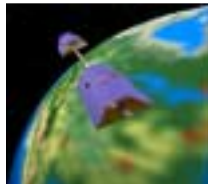
# Signal Separation Missions

**Origins Program**



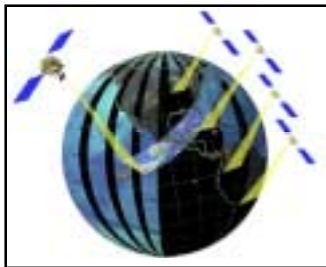**NMP**

**Structure & Evolution of the Universe**
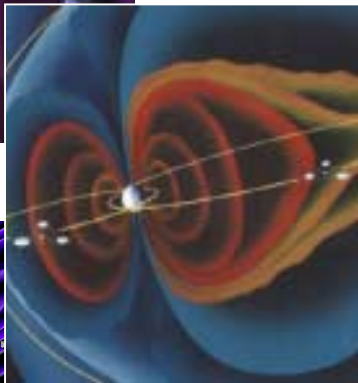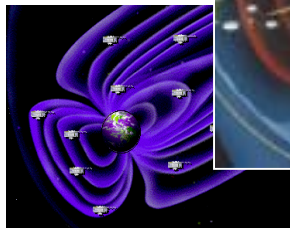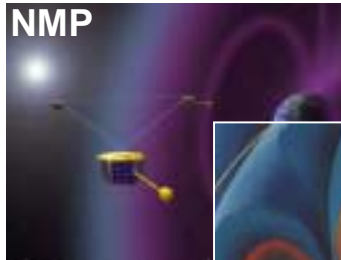


**Earth Observation**



- Motivating issues
  - Separate signals from each other and/or from noise.

- Observation characteristics
  - Spacecraft coordinate to take a single observation.

- Control characteristics
  - Activity coordination
  - Precise formation flying

# Signal Space Coverage Missions
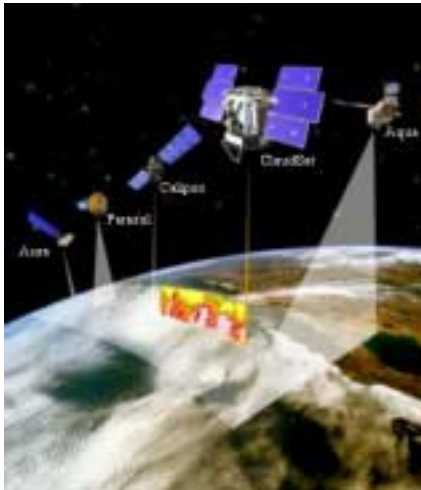
**Earth Observation**



**Sun-Earth Connections**



- Motivating issues
  - Capture all rapidly changing signals even if unpredictable.

- Observation characteristics
  - Identical spacecraft take observations that are subsequently correlated.

- Control characteristics
  - Either no coordination or coincident observations.

# Mission Combination

**Earth Observation**



**Mars Network**



- Motivating issues
  - The collection is greater than the sum of the parts. (Engineering)
- Observation characteristics
  - Multiple mission spacecraft coordinate to improve results.
- Control characteristics
  - Inter-mission coordination
  - Formation knowledge

# Autonomous Operations



GN&C

Executive

Planner

Analyst

Planner & Analyst Routines

Mission Ops.

Downlink Packets

Observation Plans & Analysis Routines

Raw Data

*Scientific Community*

Data Products

Science Ops.

Data Requests

1. Mission & Science Ops. turn data requests into onboard planner and analyst routines.

2. Analyst, Planner, and Exec. subsystems robustly command the spacecraft to collect- analyze-downlink interesting observations & telemetry

3. Mission Ops. evaluates telemetry and passes raw observation data to Science Ops.

4. Science Ops. processes the raw data into validated data products.